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THICK FILM PASTE

CLAIM(S)

A thick film paste prepared by mixing 1 – 3 weight% of glass frit in 37-59 weight% of noble metal powder, dispersing this admixture in 40 – 60 weight% of organic vehicle, and adding a filler by 300-800 ppm to said admixture.

DETAILED DESCRIPTION OF THE INVENTION

The present invention pertains to a thick film paste.

As is publicly known, the paste of this type was prepared by mixing a glass frit with a noble metal powder, and by dispersing this admixture in an organic vehicle. The film thickness after sintering was generally 15 – 25 μ, and was prepared not to be less than 6 μ however thin it may be expected. Although the paste was made to be thixotropic to prevent the paste printed on the substrate from being drained out and from ruining the shape of pattern, the paste tends to be drained out in the step section, as shown by the dotted line

in the figure when a film 3 is formed on the graze layer 2 and over to the surface of the substrate 1 in the case wherein the graze layer 2 is formed in steps on the surface of the substrate 1, as shown in the figure. Therefore, the film in this section gets thinner and in some cases the film may be torn.

On the other hand, if the film is made thick, the more amount of noble metal needs to be used. Therefore, not only the manufacturing cost becomes higher, a gas generated in or under the film during the sintering is not removed during the sintering and generates bubbles, which pushes up the film from inside or under the film. This causes local bulges in the film. This difficulty of removing the gas cannot be easily improved even if the film is sufficiently made thin.

The present invention presents a thick film paste that can prevent the deformation of even a thin film in the step section and can completely remove the gas.

The present invention presents a thick film paste prepared by mixing glass frit 1 – 3 weight% with noble metal powder 37 – 59 weight%, dispersing this admixture in organic vehicle 40 – 60 weight%, and by adding a filler at 300 – 800 ppm.

One of the characteristics of the present invention lies in that the organic vehicle is increased 3 – 8 times more than that of the prior art one, as

is evident from the earlier explanation, and the other characteristic is that a filler is added.

The organic vehicle is composed of resin and solvent, as usually is. For the resin, ethyl cellulose is used, and for the solvent, turbineol [The spelling was assumed.], or butyl carbitol acetate is used. The organic vehicle is effective for improving the thixotropy of paste. By mixing it by a large amount, the paste performance can be improved and the film is prevented from being torn at the time of printing/coating on the step section. The organic vehicle is burned away at the time of sintering, so there will be no problem even if it is mixed by a large amount. Since it burns well, the film after combustion of the vehicle become extremely thin than in the case of small content of vehicle, which is effective in making the film thinner. Moreover, if a large amount of organic vehicle is thus mixed, the mixed amount of noble metal is necessarily decreased, resulting in reduction in the amount of noble metal to be used, which is effective for cutting down the manufacturing cost. The weight ratio of the resin vs solvent is preferably 2 : 1 – 5 : 1.

As to the filler to be used, ceramic such as alumina (Al_2O_3) and titanium oxide (TiO_2) is used. If the filler with particle size 0.1 – 0.35 μ is used, the gas removal will become easy. This is due to the fact that the

boundary between the filler and the paste works as a passage for the gas removal at the time of sintering, so the gas easily passes through the passage to the surface. By this, the film bulging and film tear due to residual gas can be completely prevented.

With the past of the present invention, thixotropy is more excellent than that of the prior art one, so no deformation of the film occurred to the step section unlike the prior art paste. Therefore, the paste needs not be printed thick like the prior art paste was. By the paste of the present invention, a metal film with a 2.5 – 3 μ thickness was formed in the step section without any deformation. Since the a 6 – 8 μ thickness was needed for the prior art metal film paste, this paste of the present invention can have only a ½ of that of the prior art. By the thinner thickness of the film and by the gas removal function by use of filler, the gas can be more easily removed than in the case of thicker film, completely preventing the film bulging and tear.

As to the mixing amount of organic vehicle, about 40 – 60 weight%, more specifically, about 45 – 49 weight% is desired. With 60 weight% or more, the amount of noble metal is decreased, which makes the conductor resistance higher and is not desirable. To provide the conductor resistance with the prescribed value, it may be reasonable to increase the number of printed circuits and to make the film thicker, but this will make the film

manufacturing process more complex. With 40 weight% or less, the thixotropy will be insufficient, failing to prevent the film deformation in the step section.

The mixing amount of glass frit is not much different from that in the prior art but is slightly less. This is probably because a glassy nature of the filler functions as the glass frit. In this example, for example, borosilicate lead glass is used.

As for the noble metal powder, gold is most preferable. Besides the gold, silver, platinum, vanadium or their admixture may be used. In this invention, as mentioned earlier, a large amount of organic vehicle is used, so the amount of noble metal can be reduced corresponding to the amount of vehicle. Taking the amount of other additive into account, the amount of noble metal will be 37-59 weight%. The reduction in the amount of noble metal means that the manufacturing cost of the paste of this type is reduced, which is very advantageous.

The filler is an insulator. Therefore, if its added amount exceeds 800 ppm, it will be an obstacle in etching, making accurate etching difficult. If it is less than 800 ppm, it will be insufficient for the gas removal depending upon the use purpose.

The following table shows the composition and characteristics of the thick film paste in this example. The table also shows those in the prior art.

	Prior art	Present invention
Gold	85 weight%	51 weight%
Lead glass	3 weight%	2 weight%
Organic vehicle (ethyl cellulose turbineol)	12 weight%	47 weight%
Alumina	-	500 ppm
Sintering temperature	850°C	850°C
Sheet resistance	15mΩ/□	22mΩ/□
Film thickness	6 μ	3 μ
Frequency of printing	2 times	3 times

The aforementioned sheet resistance indicates the maximum value at film thickness 3.0 μ.

The metal film thickness made of this paste of the present invention demonstrated zero bulge in the range of 180 cm^2. With the prior art paste, the film bulge was found at 3 – 6 places in the same range of dimension. It goes without saying that there was no deformation found in the step section (about 60 μ indentation) in the film paste of the present invention.

As explained above, according to the present invention, no deformation was generated in process of printing on the step section, and therefore even if the coated film is thinner than in the prior art, the film was not torn in the step section. At the time of sintering, the gas removal was completely performed without generating the bulge in the film, which is advantageous.

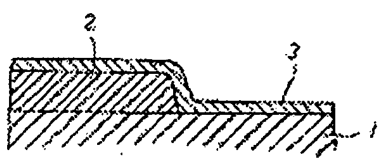
BRIEF DESCRIPTION OF THE DRAWINGS

The drawing shows a profile of the paste when coated.

1. substrate

2. glaze layer

3. film



Translations
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